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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

TITLE: LOW FLOW BAILER SYSTEM

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1. Field of The Invention

Applicant's invention relates to apparatuses for retrieving liquid samples from reservoirs of liquid.

2. Background Information

Groundwater pollution is an ever-growing concern in today's environments, and the need for groundwater monitoring is increasing, especially around chemical storage facilities, landfills, military bases, airports, and underground storage tanks.

The typical groundwater monitoring program consists of a series of monitoring wells located at different points around the margin of an aquifer, in close and distant proximities from the potential contamination source. Each monitoring well consists of a well casing which lines the well bore, the hole extending from the ground surface to the groundwater.

At least until very recently, most monitoring samples have been taken through the use of devices known as bailers. A bailer is an elongate, slender tube which is sized to pass through the well casing of a test well. The insertion end of an advanced bailed includes a one-way valve which allows

1 water to flow into the bailer as it is lowered into the well
2 casing, but hinders effluent flow as the bailer is lifted
3 from the water.

4 Bailers have been in widespread use in the groundwater
5 sampling process because they are inexpensive to purchase,
6 inexpensive to fabricate, portable, simple to operate, and
7 require no external power source. However, inherent in the
8 presently-known bailer designs, is the inability to control
9 the flow rate of the sample - a serious problem in light of
10 relatively new knowledge concerning factors affecting the
11 quality of samples taken in test wells.

12 It has been determined that if the extraction rate
13 exceeds the recharge rate, the sample may be compromised
14 through various means, including the increase of the
15 turbidity of the sample, the mixing of stagnant and fresh
16 water in the well, and the disturbance and re-suspension of
17 settled solids. The results of the sample analysis then may
18 be skewed, showing either higher or lower levels of
19 contamination in the groundwater than actually exist,
20 depending on the characteristics of the contaminant. As a
21 result, Federal and state governments now require that
22 samples of ground water be extracted at a rate not exceeding
23 the recharge rate of the sampling well. Resulting guidance

1 documents now state that bailers are ill-suited for low
2 flow. Thus, use of conventional bailers for test well
3 sampling is very nearly obsolete.

4 The preferred method for test well sampling now
5 involves the use of pumps. Ironically, although the pump
6 flow rates are easily controlled, the problems associated
7 with using pumps at test well sites are the very reasons
8 that most samplers changed from using pumps to using bailers
9 in the past. Pumps are expensive, harder to clean and
10 operate, and require an external power source. Pumps also
11 have go through general maintenance procedures to maintain
12 the life of the pumps, increasing the cost.

13 In view of the foregoing, it would well serve those
14 involved in test well monitoring to provide some means by
15 which test well sample may be taken with the simplicity and
16 economy of bailers, yet still comply with the new low-flow
17 sampling requirements.

18 19 SUMMARY OF THE INVENTION

20 It is an object of the present invention to provide an
21 improved bailer to allow for low flow sampling as is
22 desirable to obtain quality samples from ground water test
23 wells and, in some cases, required by the governmental

1 regulations, in any event to provide an alternative to
2 presently available, and much more expensive alternatives
3 for obtaining such samples.

4 In satisfaction of these and related objectives,
5 Applicant's present invention provides a bailer of an
6 improved design which allows for the variance of flow into
7 the bailer through use of attachments with varying inflow
8 orifice sizes. As the size of the orifice changes, the
9 weight of the apparatus can also be changed allowing for an
10 only slightly negative buoyancy of the apparatus. The
11 attachment may also be designed to include features for
12 filtering unwanted particulates from the sample.

13 14 BRIEF DESCRIPTION OF THE DRAWINGS

15 FIG. 1 is an elevational side view of the Applicant's
16 improved bailer with low-flow attachment engaged.

17 FIG. 2 is an elevations side view of the Applicant's
18 low-flow attachment incorporating the filtering device.

19 20 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

21 Referring to FIG. 1, the bailer of Applicant's
22 invention is identified by the reference numeral 10. The

1 preferred embodiment of bailer 10 includes a cylindrical,
2 plastic tube 12.

3 The bailer has an insertion or distal end 14 and a
4 proximal end 16. The preferred embodiment of Applicant's
5 bailer 10 includes a distal terminus cap 18 and a proximal
6 terminus cap 20, and a negative buoyancy device 23 and
7 housing 24. Proximal terminus cap 20 includes a generally
8 dome-shaped portion 24 from which extends a nesting lip 22.

9 Nesting lip 22 extends from the margin of the dome
10 portion 24 of cap 20 to generally define a cylindrical
11 structure which snugly nests within the lumen of plastic
12 tube 12. To insure that proximal terminus cap 20 does not
13 accidentally disengage from plastic tube 12, the two should
14 be suitably bonded together (such as through use of sonic
15 welding) during assembly of bailer 10 through means
16 appropriate for the material from which bailer 10 is
17 fabricated (polyethylene in the case of Applicant's current
18 preferred embodiment).

19 The preferred embodiment of proximal terminus cap 20
20 has two attachment orifices 26 passing through the
21 dome-shaped portion 24. Attachment orifice 26 provide the
22 means by which bailer 10 is attached to cording (not shown

1 in the drawings) by which bailer 10 will be lowered into and
2 removed from a well.

3 A terminal segment of cording will be passed through a
4 first orifice 26 from the convex side of dome-shaped portion
5 24, and then passed through the other orifice 26 from the
6 concave side of dome-shaped portion 24. In order to insure
7 that bailer 10 assumes as near a vertical orientation as
8 possible as it is suspended from a cord during sample
9 taking, orifices 26 should reside as mirror images of each
10 other on either side of a bisecting line which divides
11 equally the dome-shaped portion 24 of terminus cap 20. For
12 the same reason, the axis of symmetry of dome-shaped portion
13 24 should, when terminus cap 20 is installed on plastic tube
14 12, correspond to the longitudinal axis of symmetry of
15 plastic tube 12.

16 The configuration of proximal terminus cap 20 as just
17 described virtually eliminates the possibility of a bailer
18 10 becoming lodged against some irregularity in the well
19 casing surface. Unlike the angular margins of presently
20 available bailers, the purely rounded surfaces of
21 Applicant's bailer 10 will simply slide past all
22 obstructions in the well casing, except those which would

1 have prevented initial insertion of bailer 10 in the first
2 place.

3 The preferred embodiment of the negative buoyancy
4 device 23 is a series of masses, in which the weight of the
5 apparatus can be changed by removing or adding mass. The
6 weight of the apparatus is used to aid in the control of the
7 flow rate into the apparatus. The negative buoyancy device
8 is enclosed in housing 25, which keeps the weights separate
9 from the sample, thereby avoiding contamination. The
10 preferred embodiment of the housing 25 is a cylindrical
11 casing that should be permanently bonded to the bailer and
12 is made of an inert material, to avoid contamination.

13 Distal terminus cap 18 also includes a generally
14 dome-shaped portion 28 from which extends a nesting lip 30.
15 Nesting lip 30 is configured substantially identically to
16 nesting lip 22 of proximal terminus cap 20 and is attached
17 in the same manner.

18 The preferred embodiment of distal terminus cap 18
19 exhibits an intake orifice 32, a flow control insert 31, and
20 a flow control orifice 33, through which water passes when
21 gathering a test sample. The orifice 32 is, in the preferred
22 embodiment surrounded by an annular flange 34 which serve to
23 prevent interference with operation of the ball valve 36 by

1 objects which may contact the distal end 14 of bailer 10.
2 The flow control insert 31, in the preferred embodiment is
3 compression fit to the intake orifice 32 to shut off flow
4 around the insert and direct the flow through the flow
5 control orifice 33. The flow control orifice 33, in the
6 preferred embodiment is centered on the inserted end of the
7 flow control insert. The flow control orifice size varies
8 and combined with the amount of weight in the negative
9 buoyancy device 23 can control the fill rate of the
10 apparatus ranging from less than 100 milliliters per minute
11 to over 1 liter per minute.

12 The flow control insert 31 in may also be covered with
13 a particulate filtering device 40 as shown in Fig 5. The
14 filtering device of covers the in-take end of the flow
15 control insert. It is used to prevent clogs occurring in the
16 flow control orifice. The preferred embodiment of the
17 filtering device is a stainless steel mesh screen that is
18 placed over the protruding end of the flow control insert.

19 As with proximal terminus cap 20, distal terminus cap
20 18 is configured whereby the axis of symmetry of dome-shaped
21 portion 28 should, when terminus cap 18 is installed on
22 plastic tube 12, correspond to the longitudinal axis of
23 symmetry of plastic tube 12. The orifice 32 is, in turn,

1 centered on the same axis of symmetry of plastic tube 12.
2 This configuration insures that orifice 32 (and flange 34)
3 is directed parallel with the path of bailer 10 and is less
4 likely to scrap sediment, etc. from the casing wall as the
5 bailer 10 is lowered for sample gathering, and thereby risk
6 contamination of the sample.

7 While the greater concern which is addressed by the
8 rounding of margins for bailer 10 is that of avoiding
9 juxtaposition of a proximal, angular margin with a casing
10 surface irregularity after the bailer is inserted into a
11 well casing, the rounding of the distal end 14 surfaces of
12 bailer 10 also has significant utility.

13 Certain irregularities in well casings are not so
14 profound as to risk trapping the bailer 10 in the well
15 casing. Nevertheless, some irregularities may be pronounced
16 enough such that an angular margin on the distal end of a
17 bailer will abut the irregularity and thereby suspend the
18 bailer above the level intended for sample taking.

19 Additionally, the engagement of a sharp edge with a
20 well casing wall as the bailer is lowered may dislodge
21 sediments and other accumulations on the well casing surface
22 which may lead to local contamination of the underlying
23 water supply to an extent which may render the sample

1 unrepresentative of the actual over-all state of the water
2 supply. In certain cases, this could lead to a "false
3 positive" for serious levels of contaminants in a water
4 supply, with potentially very costly and disquieting
5 results. If, for example, a well test revealed an abnormal
6 level of, perhaps, a heavy metal which had accumulated on
7 the casing wall over time, but which was not at dangerous
8 levels in the actual water supply, environmental regulations
9 might, in the case of a producing water well, dictate
10 suspension of operation of the subject well, and in other
11 cases lead to costly investigations of nearby candidates for
12 sources of pollution.

13 Although the invention has been described with
14 reference to specific embodiments, this description is not
15 meant to be construed in a limited sense. Various
16 modifications of the disclosed embodiments, as well as
17 alternative embodiments of the inventions will become
18 apparent to persons skilled in the art upon the reference to
19 the description of the invention. It is, therefore,
20 contemplated that the appended claims will cover such
21 modifications that fall within the scope of the invention.
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